Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.33501

The evolution, migration and transformation of dissolved organic matter in a black shale region

YINBO XU[1,2], QINGJUN GUO[1,2] AND GUANGXU ZHU[1,2]

[1]College of Resources and Environment, University of Chinese Academy of Sciences

[2]Center for Environmental Remediation, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences

Dissolved organic matter (DOM), an important and highly dynamic carbon reservoir in the global carbon cycle, is key to deciphering the global carbon cycle and linked biogeochemical dynamics. Meanwhile, the weathering of black shales represents a critical pathway for the release of petrogenic organic carbon into the modern carbon cycle. Despite its potential importance, the molecular-level processes governing the fate of this ancient DOM remain elusive. Therefore, the integrated molecular composition, thermodynamic analysis, and reaction kinetics were employed to track the transformation of shale-derived DOM across rock-soil-water continua. Results reveal that the DOM pool is overwhelmingly dominated by aromatic compounds (e.g., lignins, ~64%; tannins, ~11%), indicating the release of a recalcitrant, energy-poor carbon base. Notably, molecular network analysis reveals an active, bidirectional transformation core between lignins and tannins, demonstrating that this carbon is not inert but dynamically repackaged despite its overall persistence. Thermodynamics ($\Delta G_{cox} \approx$ -118 to -124 kJ/mol-C) suggest oxidation is favorable, yet kinetic constraints ($\lambda \approx 0.041$–0.046) compete with physical transport. This competition dictates distinct environmental fates: hydrophobic lipids accumulate in water (4.7% to 9.7%) because ther slow degradation outpaces migration, while reactive tannins decline sharply (11.1% to 2.3%) due to efficient microbial degradation and mineral stabilization in soils. Our findings establish that petrogenic carbon undergoes complex molecular recycling rather than simple degradation. This dynamic view resolves the paradox of its apparent persistence and continuous molecular renewal.

